

CHAPTER 4. WATER QUALITY

METHODS

Water Temperature

Nine temperature recorders were originally installed in the San Juan and Animas rivers in July and August of 1992 at the locations shown in Table 4.1. Each station consisted of a temperature sensor, lead wires and an OMNIDATA DP-230 data pod. The temperature was sampled every 10 minutes and stored every 24 hours as a maximum, minimum and mean temperature for the day. Table 2.2 also shows the periods of record at each site. The missing data were caused by equipment problems. Due to equipment problems and other maintenance challenges, the temperature recorders were replaced in July 1999 with the Optic StowAway temperature loggers. These are manufactured by Onset Computer Corporation and are factory sealed, submersible units that communicate via an optic interface. The temperature sensor is embedded in the body of the unit, eliminating any external wires. Water temperature is currently recorded every 15-minutes. The “in place” phrase in Table 4.1 indicates that StowAway’s are monitoring temperature at the indicated sites.

Water Chemistry

Twelve water quality monitoring sites (Table 4.2) were identified as necessary to characterize water quality in the San Juan River and key tributaries. Sampling interval are quarterly (trimonthly) in February, May, August, and November. This temporal spacing was adopted to ensure water sampling occurs during spring runoff in the upper portion of the San Juan River basin and during winter base flows.

Chemical analyses performed are listed in Table 4.3. Parameters listed in left column were measured quarterly. In addition, field measurements of water temperature, pH, redox potential, specific conductance, and dissolved oxygen were made. Annually, during low-flow periods in February, water samples were analyzed for all parameters listed in Table 4.3.

RESULTS

Water Temperature

The plot of the 2000 StowAway temperature data is shown in Figure 4.1. Maximum, minimum and average plots are shown for Archuleta and Montezuma Creek in Figures 4.2 and 4.3. The new equipment is operating well and is providing a more consistent and reliable record.

Table 4.1. Water temperature monitoring locations and period of record.

Location	RM	Period of Record
Near Navajo Dam	225	7/9/1999 to 12/31/00 (in place)
Archuleta - San Juan at USGS Gage Location	218.6	7/23/92 to 12/31/00 (in place)
Blanco - San Juan at US-64 Bridge	207.1	8/7/92 to 2/28/95 (missing 11/21 - 12/9/92)
Bloomfield - San Juan at Highway 44 Bridge	195.6	2/27/93 to 7/17/98
Lee Acres - San Juan at Lee Acres Bridge	188.9	8/8/92 to 12/2/92, 2/26/93 to 4/15/93, 5/27/93 to 9/6/94, 3/9/95 to 10/10/95
Farmington - San Juan at USGS Gage Location	180.1	8/5/92 to 1/16/96, 7/8/99 to 12/31/00 (in place)
Shiprock - San Juan at USGS Gage Location	148.0	7/8/99 to 12/31/00 (in place)
Four Corners - San Juan at USGS Gage Location	119.4	10/7/94 to 3/11/96*, 7/9/99 to 12/31/00 (in place)
Montezuma Creek - San Juan at Montezuma Creek Bridge	93.6	8/9/92 to 1/11/93, 2/25 to 3/14/93, 4/14 to 5/10/93, 5/28/93 to 12/31/00 (in place)
Mexican Hat - San Juan near Bluff Gage Location	52.1	7/9/99 to 12/31/00 (in place but not submerged in late 2000)
Cedar Hill - Animas at USGS Gage nr Cedar Hill	n/a	8/7/92 to 9/22/98
Farmington - Animas at USGS Gage Location	n/a	8/5/92 to 4/14/97, 5/7/97 to 8/26/97, 10/15/97 to 6/4/98, 7/8/99 to 12/31/00 (in place)
USGS Data - San Juan at Archuleta	218.6	10/1/50 - 9/30/68 with some missing data
USGS Data - San Juan at Shiprock	148.0	10/1/51 - 9/30/86, 9/7/91 - 3/3/93 with some missing data
USGS Data - Animas	n/a	10/1/52 - 9/30/90 with some missing data

Note all locations missing October 1992 data

* installed 8/10/92 but bad data was logged until thermistor was changed in October 1994. Prior to this time it was thought sediment accumulation was causing the warmer readings instead of bad thermistor.

Table 4.2. San Juan River water quality monitoring sites.

Station Name	USGS ID	USGS Record	BIA Record
San Juan River near Archuleta Bridge	9355500	1958 -1984	1991-2000
Animas River @ Farmington	9364500	1958 -1992	1991-2000
San Juan River @ Farmington	9365000	1974 -1991	1991-2000
LaPlata River near Farmington	9367500	1977-1991	1994-2000
San Juan River @ Shiprock	9368000	1958 -1992	1991-2000
Mancos River near Four Corners	9371005		1991-2000
San Juan River @ Four Corners	9371010	1977-1990	1991-2000
San Juan River @ Montezuma Creek	9378610		1991-2000
San Juan River @ Bluff	9379495		1991-2000
San Juan River near Bluff (@ Mex. Hat)	9379500	1974 -1993	1991-2000

Table 4.3. San Juan River Monitoring Program water quality parameters.

Quarterly	Detection	Annually	Detection
Arsenic (total & dissolved)	0.5 µg/L	Aluminum (total & dissolved)	0.2 mg/L
Calcium (dissolved)	0.2 mg/L	Barium (total & dissolved)	20 µg/L
Copper (total & dissolved)	0.5 µg/L	Manganese (total & dissolved)	30 µg/L
Lead (total & dissolved)	40 µg/L	Nickel (total & dissolved)	50 µg/L
Magnesium (dissolved)	0.2 mg/L	Potassium (total & dissolved)	2 mg/L
Mercury (total & dissolved)	0.2 µg/L	Strontium (total & dissolved)	50 µg/L
Sodium (dissolved)	2 mg/L	Orthophosphate (total & dissolved)	5 mg/L
Selenium (total, dissolved, & total recoverable)	1 µg/L	Chloride (dissolved)	10 mg/L
Zinc (total & dissolved)	10 µg/L	Ammonia (dissolved)	50 µg/L
Alkalinity (HCO ₃)	2 mg/L	Nitrate (dissolved)	20 µg/L
Hardness	1 mg/L	Nitrite (dissolved)	10 µg/L
TDS	10 mg/L	Silica (total & dissolved)	1 mg/L
TSS	5 mg/L	Sulfate (dissolved)	100 mg/L
Turbidity	0.1 NTU		

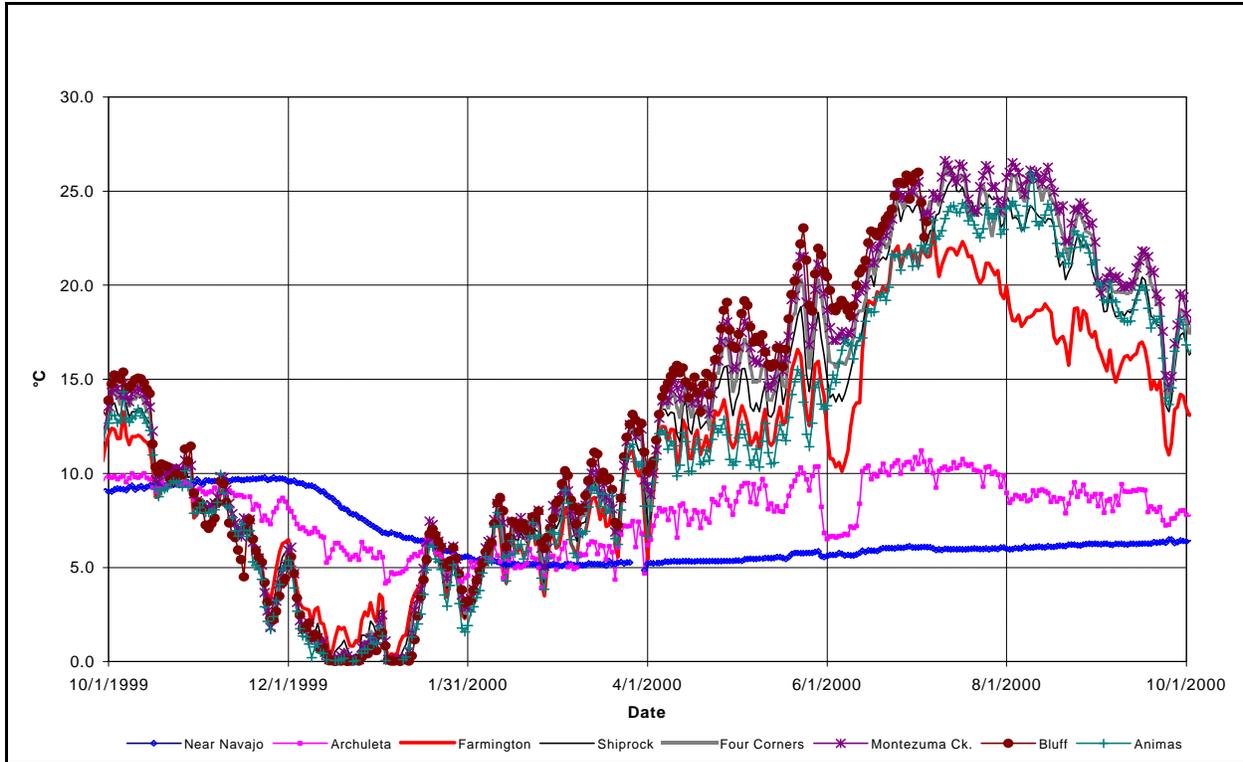


Figure 4.1. San Juan Basin Average Water Temperature Data

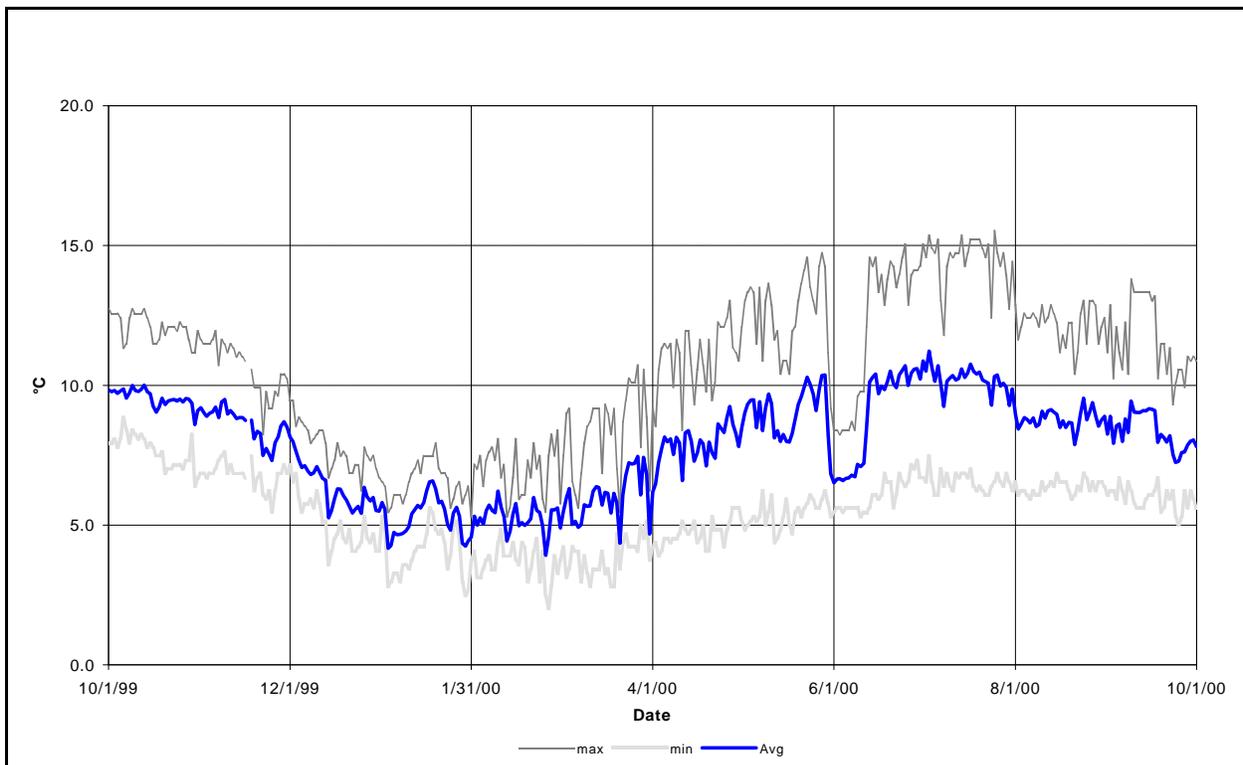


Figure 4.2 Archuleta Maximum, Minimum and Average Water Temperatures

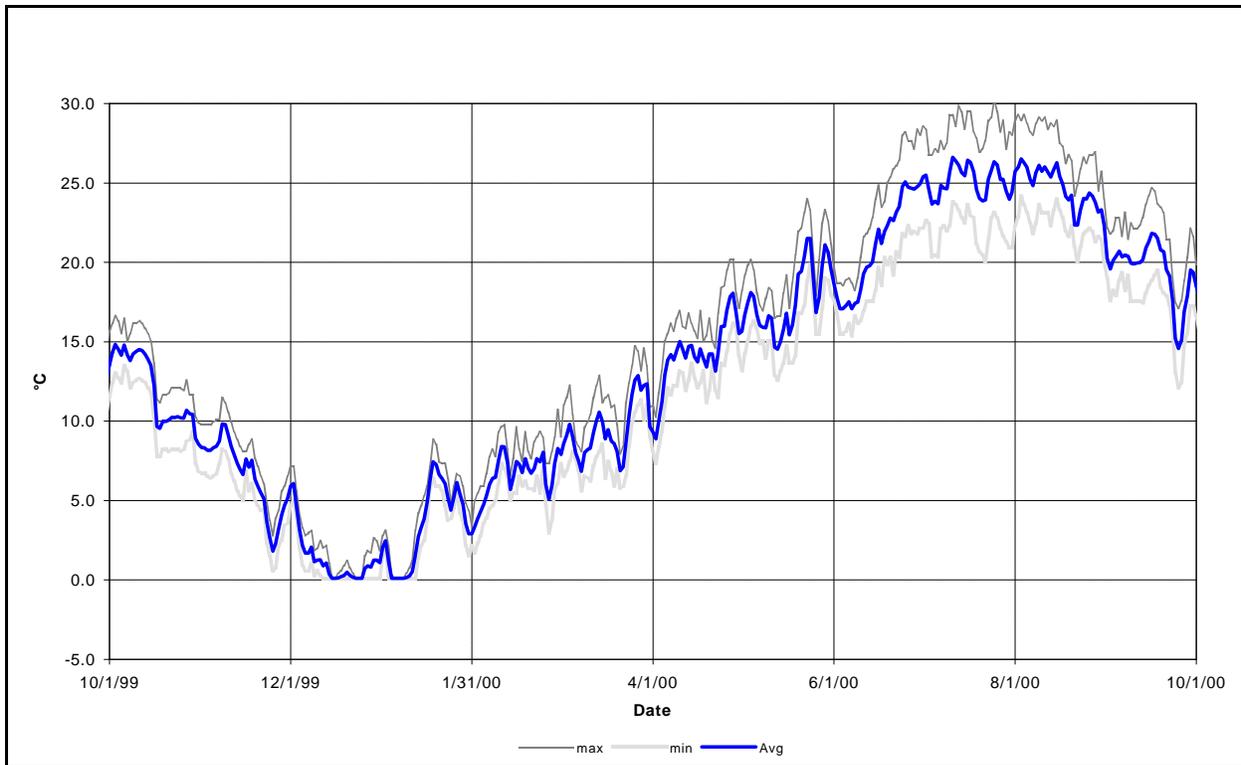


Figure 4.3 Montezuma Creek Maximum, Minimum and Average Water Temperatures.

Water Chemistry

Tables 4.4 through 4.13 summarize the water quality data for the 10 permanent stations, comparing the 1994 -1999 statistics to those for 2000. In each case the minimum, maximum, mean and standard deviation is given for each parameter in Table 4.3. When values fall below detection, they are shown at $\frac{1}{2}$ detection limit.

Table 4.4. Water chemistry data for San Juan River at Archuleta Bridge

San Juan River at Archuleta Bridge 1994-1999						2000				
Parameter	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	35	43	99	74.2	9.6	4	68	74	70.5	3
Alkalinity (mg/l)	35	43	99	74.6	9.7	4	68	76	72.5	3.4
Arsenic dissolved (µg/l)	63	0.3	2.5	1.9	0.8	4	0.3	1.5	0.8	0.5
Arsenic total (µg/l)	63	0.5	642	12.5	80.6	4	0.5	0.5	0.5	0
Calcium dissolved (mg/l)	35	25.1	33.6	29.2	2.5	4	26.4	28.5	27.4	1.2
Copper dissolved (µg/l)	35	1	21	3.7	3.5	4	0.9	1.5	1.3	0.3
Copper total (µg/l)	35	1	41	7.4	9.9	4	2	4	2.5	1
Hardness ((mg/l)	35	83	112	96.1	8.2	4	86	93	89.3	3.3
Mercury dissolved (µg/l)	63	0.1	0.5	0.1	0.1	4	0.1	0.1	0.1	0
Mercury total (µg/l)	63	0.1	0.1	0.1	0	4	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	35	4.9	6.9	5.6	0.5	4	4.9	5.3	5.1	0.2
Sodium dissolved (mg/l)	12	10.7	15.3	12.8	1.3	4	11.4	12.5	12.1	0.5
Lead dissolved (µg/l)	63	0.1	5.7	0.6	0.9	4	0.1	0.3	0.1	0.1
Lead total (µg/l)	63	0.1	19.2	1.3	2.6	4	0.1	0.5	0.2	0.2
Selenium dissolved (µg/l)	63	0.5	0.5	0.5	0	4	0.5	0.5	0.5	0
Selenium total (µg/l)	63	0.5	3	0.6	0.3	4	0.5	0.5	0.5	0
Selenium total recoverable (µg/l)	13	0.5	0.5	0.5	0	4	0.5	0.5	0.5	0
Total dissolved solids (mg/l)	33	90	280	160	39.7	4	120	150	130	14.1
Total suspended solids (mg/l)	62	1	57	9	10.1	4	2.5	2.5	2.5	0
Turbidity (NTU)	60	0	33	5.9	5.3	4	1.3	6	3	2.1
Zinc dissolved (µg/l)	63	5	70	7.2	8.9	4	5	20	13.8	7.5
Zinc total (µg/l)	63	5	360	26.3	53.3	4	5	10	8.8	2.5
Temperature (°C)	63	3.4	19.9	8.1	2.9	4	6.3	10.1	8	1.8
pH	63	7.2	9	8.2	0.4	4	7.5	9.1	8.4	0.6
Conductance (µmhos/cm)	63	200	1210	250	124.8	4	200	220	210	7.9
Redox Potential (mv)	63	223	527	379	71	4	257	455	392	90.9
Oxygen dissolved (mg/l)	62	5.4	14.3	10.5	1.5	4	10.1	12.4	10.8	1.1

Table 4.5. Water Chemistry data for Animas River at Farmington

Animas River at Farmington Parameter	1994-1999					2000				
	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	34	43	171	118	34.2	4	70	177	139	48.7
Alkalinity (mg/l)	34	43	171	118.7	34.4	4	70	177	139	48.7
Arsenic dissolved (µg/l)	63	0.3	2.5	1.9	0.8	4	0.3	1	0.7	0.4
Arsenic total (µg/l)	63	0.5	13	2.6	1.8	4	0.5	2	1.1	0.8
Calcium dissolved (mg/l)	34	27.6	101	68.9	22.1	4	36.8	103	84	31.7
Copper dissolved (µg/l)	34	1	9	3.9	2.1	4	1.4	4.2	2.3	1.3
Copper total (µg/l)	34	1.5	68	14	14.4	4	3	33	12.5	13.9
Hardness ((mg/l)	34	85	319	218.5	72.3	4	114	317	260.8	98.2
Mercury dissolved (µg/l)	63	0.1	0.1	0.1	0	4	0.1	0.1	0.1	0
Mercury total (µg/l)	63	0.1	0.9	0.1	0.1	4	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	34	3.8	19.2	11.3	4.2	4	5.3	15.6	12.3	4.7
Sodium dissolved (mg/l)	11	6	37.7	24.5	11.1	4	8	40.9	29.7	14.9
Lead dissolved (µg/l)	63	0.1	4.5	0.5	0.6	4	0.2	0.7	0.3	0.3
Lead total (µg/l)	63	0.5	80	14.1	18.7	4	0.6	55.7	16.9	26.2
Selenium dissolved (µg/l)	63	0.5	3	0.6	0.3	4	0.5	1	0.6	0.3
Selenium total (µg/l)	63	0.5	4	0.6	0.5	4	0.5	0.5	0.5	0
Selenium total recoverable (µg/l)	13	0.5	1	0.5	0.1	4	0.5	0.5	0.5	0
Total dissolved solids (mg/l)	33	110	520	321.8	121.8	4	150	480	380	154.3
Total suspended solids (mg/l)	62	1	2170	140.3	321.1	4	8	276	125.5	131.8
Turbidity (NTU)	60	0.9	1240	72.5	189.4	4	2.1	1030	270.8	506.4
Zinc dissolved (µg/l)	63	5	40	9.6	7.3	4	10	30	20	8.2
Zinc total (µg/l)	63	5	430	86.7	84.8	4	30	290	105	124.8
Temperature (°C)	63	-0.2	27.3	11.5	6.9	4	3.3	22.2	12.4	8.5
pH	63	7.5	8.9	8.2	0.3	4	7.9	8.3	8.1	0.2
Conductance (µmhos/cm)	63	200	970	550	181	4	250	750	590	225.8
Redox Potential (mv)	63	253	545	396	65.2	4	341	480	423	63.1
Oxygen dissolved (mg/l)	62	3.7	13.2	9.5	2.1	4	6.9	12.3	9.5	2.3

Table 4.6. Water Chemistry data for San Juan River at Farmington Bridge

San Juan River at Farmington Bridge Parameter	1994-1999					2000				
	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	33	49	143	102.6	22.2	4	77	110	99	15.3
Alkalinity (mg/l)	33	49	143	102.9	21.8	4	77	110	99	15.3
Arsenic dissolved (µg/l)	63	0.3	5	2	0.9	4	0.3	1.5	0.8	0.6
Arsenic total (µg/l)	63	0.5	7	2.5	1.2	4	0.5	4	1.9	1.5
Calcium dissolved (mg/l)	33	28.8	83.5	53.7	14.9	4	38.4	58.2	51.2	8.9
Copper dissolved (µg/l)	33	1	10	3.9	2.4	4	0.8	3.6	1.9	1.2
Copper total (µg/l)	33	2.5	50	15.7	12.2	4	3	32	15.3	14.6
Hardness ((mg/l)	33	91	265	170.1	47	4	119	183	159	27.8
Mercury dissolved (µg/l)	63	0.1	0.2	0.1	0	4	0.1	0.1	0.1	0
Mercury total (µg/l)	63	0.1	0.2	0.1	0	4	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	33	4.6	13.9	8.7	2.4	4	5.6	9.1	7.6	1.6
Sodium dissolved (mg/l)	10	12.2	46.7	32.3	10.2	4	13.4	37.1	29.3	10.9
Lead dissolved (µg/l)	63	0.1	4	0.5	0.6	4	0.1	0.6	0.3	0.3
Lead total (µg/l)	63	0.5	105	11.6	16	4	1.1	49.8	18.1	22.8
Selenium dissolved (µg/l)	63	0.5	2	0.6	0.2	4	0.5	0.5	0.5	0
Selenium total (µg/l)	63	0.5	2.5	0.6	0.3	4	0.5	0.5	0.5	0
Selenium total recoverable (µg/l)	13	0.5	0.5	0.5	0	4	0.5	0.5	0.5	0
Total dissolved solids (mg/l)	33	140	450	290	84.3	4	180	300	265	56.9
Total suspended solids (mg/l)	62	2.5	2660	239.7	387.1	4	22	1070	332.5	499.8
Turbidity (NTU)	60	2.5	1880	106	256.8	4	11.2	7400	1866.5	3689
Zinc dissolved (µg/l)	63	5	30	7.5	5.7	4	5	20	13.8	7.5
Zinc total (µg/l)	63	5	320	61.8	52.9	4	10	260	95	115.6
Temperature (°C)	63	-0.3	24.3	10.5	6.2	4	1.3	20.7	11.7	8.9
pH	63	7.2	8.8	8.1	0.3	4	7.8	8.3	8	0.3
Conductance (µmhos/cm)	63	200	700	430	118.9	4	290	620	520	152.4
Redox Potential (mv)	63	252	535	402	60.3	4	352	457	423	49.6
Oxygen dissolved (mg/l)	62	0	12.5	8.9	2.2	4	6.9	12.1	9.1	2.3

Table 4.7. Water chemistry data for La Plata River near Farmington

La Plata River near Farmington Parameter	1994-1999					2000				
	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	25	111	370	231.6	55.2	2	246	250	248	2.8
Alkalinity (mg/l)	25	111	370	231.6	55.1	2	246	250	248	2.8
Arsenic dissolved (µg/l)	54	0.2	5	2.3	0.9	2	1.5	2.9	2.2	1
Arsenic total (µg/l)	54	0.5	29	4.2	5.2	2	1.5	3	2.3	1.1
Calcium dissolved (mg/l)	25	65.4	507	181.3	96.2	2	178	339	258.5	113.8
Copper dissolved (µg/l)	25	1	20	8.6	5.5	2	1.5	16	8.8	10.3
Copper total (µg/l)	25	1.5	136	23.1	28.2	2	4	6	5	1.4
Hardness ((mg/l)	25	279	2120	798.1	409.6	2	850	1520	1185	473.8
Mercury dissolved (µg/l)	54	0.1	0.1	0.1	0	2	0.1	0.1	0.1	0
Mercury total (µg/l)	54	0.1	1.7	0.2	0.3	2	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	25	18.1	208	83.8	42.9	2	98.6	163	130.8	45.5
Sodium dissolved (mg/l)	5	56.7	453	214.7	162.5	2	129	546	337.5	294.9
Lead dissolved (µg/l)	54	0.1	1	0.4	0.2	2	0.1	0.3	0.2	0.1
Lead total (µg/l)	54	0.3	408	16.8	58.3	2	0.3	1.7	1	1
Selenium dissolved (µg/l)	54	0.5	4	1.2	0.9	2	0.5	2	1.3	1.1
Selenium total (µg/l)	54	0.5	10	1.5	1.7	2	0.5	2	1.3	1.1
Selenium total recoverable (µg/l)	9	0.5	2	1.1	0.6	2	0.5	2	1.3	1.1
Total dissolved solids (mg/l)	25	80	3240	1366	750.8	2	1510	3780	2645	1605.1
Total suspended solids (mg/l)	54	2	65600	1981.3	9329	2	32	120	76	62.2
Turbidity (NTU)	54	0.1	18900	552.9	2592.6	2	1.5	62	31.8	42.8
Zinc dissolved (µg/l)	54	5	20	6.5	3.7	2	10	20	15	7.1
Zinc total (µg/l)	54	5	1850	81.5	263.9	2	20	30	25	7.1
Temperature (°C)	54	-0.3	32.2	12.9	8.7	2	0.8	29.5	15.1	20.4
pH	54	7	8.5	8.1	0.3	2	8	8	8	0
Conductance (µmhos/cm)	54	270	3740	1700	729.3	2	1790	4190	2990	1697.1
Redox Potential (mv)	54	239	498	390	61.3	2	378	481	430	72.8
Oxygen dissolved (mg/l)	53	3.1	12.8	8.8	2.2	2	6.4	11.9	9.2	3.9

Table 4.8. Water chemistry data for San Juan River at Shiprock Bridge

San Juan River at Shiprock Bridge 1994-1999						2000				
Parameter	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	63	17	165	108.1	29.2	8	72	126	110.9	24
Alkalinity (mg/l)	63	17	166	109.3	29.7	8	72	126	110.9	24
Arsenic dissolved (µg/l)	122	0.5	2.5	2	0.8	8	0.5	5	1.7	1.4
Arsenic total (µg/l)	121	0.5	44	4.1	5.8	8	0.5	4	1.9	1.4
Calcium dissolved (mg/l)	63	30.8	96.3	59.6	16.4	8	37.2	72.4	61.9	15.2
Copper dissolved (µg/l)	63	1	18	4.6	3.2	8	1.3	5	2.7	1.3
Copper total (µg/l)	63	2.5	155	28.6	31.5	8	3	26	13.5	11.3
Hardness ((mg/l)	63	98	317	194.7	55.7	8	117	236	198	50.9
Mercury dissolved (µg/l)	122	0.1	0.3	0.1	0	8	0.1	0.1	0.1	0
Mercury total (µg/l)	122	0.1	1.6	0.1	0.2	8	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	63	5.2	18.6	11.1	3.7	8	5.8	15	10.5	3.7
Sodium dissolved (mg/l)	16	13	58.5	37.3	12.9	8	13.7	51.2	39.2	16
Lead dissolved (µg/l)	122	0.1	18	0.9	2.4	8	0.1	1	0.5	0.3
Lead total (µg/l)	121	0.5	323	26.4	44.4	8	1.5	38.1	16.9	14.2
Selenium dissolved (µg/l)	122	0.5	1	0.5	0.1	8	0.5	0.5	0.5	0
Selenium total (µg/l)	122	0.5	3	0.7	0.4	8	0.5	1	0.6	0.2
Selenium total recoverable (µg/l)	26	0.5	2	0.7	0.3	8	0.5	0.5	0.5	0
Total dissolved solids (mg/l)	62	130	550	339.4	104.3	8	170	410	338.8	101.8
Total suspended solids (mg/l)	120	2.5	17700	1047	3006.6	8	34	878	284.3	358.8
Turbidity (NTU)	118	3.8	11100	538.2	1680.2	8	5.2	7440	1425	2769.9
Zinc dissolved (µg/l)	122	5	50	7.3	6	8	5	30	15.6	8.2
Zinc total (µg/l)	122	5	1380	122.3	225.1	8	20	150	67.5	57.3
Temperature (°C)	122	0.1	26.1	12.2	6.8	8	3.6	22.5	13.3	8
pH	122	7.7	9	8.3	0.3	8	7.8	8.7	8.2	0.4
Conductance (µmhos/cm)	122	240	830	520	148.4	8	280	600	520	145.8
Redox Potential (mv)	122	250	544	408	63.3	8	339	474	429	57.1
Oxygen dissolved (mg/l)	120	3.6	13.9	9.5	2.3	8	6.8	12.6	9.7	2.6

Table 4.9. Water chemistry data for Mancos River near Four Corners

Parameter	1994-1999					2000				
	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	29	92	360	168.9	55.1	3	171	258	216.7	43.7
Alkalinity (mg/l)	29	92	360	171.7	54.8	3	175	258	218	41.6
Arsenic dissolved (µg/l)	52	0.3	5	2.1	0.9	3	1	3	1.7	1.1
Arsenic total (µg/l)	52	1	37	5.5	7.6	3	1.5	2	1.7	0.3
Calcium dissolved (mg/l)	29	43.6	211	134.4	52.9	3	132	225	181.7	46.8
Copper dissolved (µg/l)	29	2.5	20	9	5.6	3	1.5	5.2	3.9	2.1
Copper total (µg/l)	29	1.5	198	34.3	43.8	3	3	10	6	3.6
Hardness ((mg/l)	29	165	1110	639.9	288.1	3	624	1110	908.7	253.5
Mercury dissolved (µg/l)	52	0.1	0.1	0.1	0	3	0.1	0.1	0.1	0
Mercury total (µg/l)	52	0.1	2	0.2	0.3	3	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	29	13.7	145	73.9	39.6	3	71.5	132	110.2	33.6
Sodium dissolved (mg/l)	6	22	206	108.3	73.9	3	104	188	154.3	44.4
Lead dissolved (µg/l)	52	0.1	1	0.4	0.2	3	0.1	0.3	0.2	0.1
Lead total (µg/l)	52	0.2	78.6	11.5	19.7	3	0.4	3.4	1.5	1.7
Selenium dissolved (µg/l)	52	0.5	30	7.6	6.2	3	8	16	12.3	4
Selenium total (µg/l)	52	0.5	30	7.6	5.9	3	6	14	11.3	4.6
Selenium total recoverable (µg/l)	13	2	16	8.5	4.9	3	5	17	11.7	6.1
Total dissolved solids (mg/l)	28	240	2100	1174.6	556.6	3	1050	2100	1640	536.9
Total suspended solids (mg/l)	51	2.5	33500	1250.8	4754.7	3	14	120	50.7	60.1
Turbidity (NTU)	51	3.9	18500	644.3	2596.3	3	4.8	277	101.2	152.5
Zinc dissolved (µg/l)	52	5	40	7.3	6.2	3	5	10	6.7	2.9
Zinc total (µg/l)	52	5	2300	100.1	319.8	3	5	30	15	13.2
Temperature (°C)	52	-0.2	32.3	12.4	8.5	3	0.7	22.3	10.5	11
pH	52	7.8	8.8	8.2	0.2	3	8	8.3	8.2	0.2
Conductance (µmhos/cm)	52	380	2450	1520	594.8	3	1400	2370	1930	494.9
Redox Potential (mv)	52	4	548	402	85.4	3	308	451	396	76.8
Oxygen dissolved (mg/l)	51	4.8	12.7	9.3	2	3	7.9	12.2	10.2	2.1

Table 4.10. Water chemistry data for San Juan River at Four Corners Bridge

San Juan River at Four Corners Bridge Parameter	1994-1999					2000				
	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	34	67	165	113.5	23.3	4	91	129	117	17.8
Alkalinity (mg/l)	34	67	165	114.1	23.6	4	91	129	117	17.8
Arsenic dissolved (µg/l)	63	0.5	2.5	2	0.8	4	0.6	1.5	1	0.5
Arsenic total (µg/l)	63	1	19	3.6	3.3	4	0.5	7	2.9	2.9
Calcium dissolved (mg/l)	34	31.7	99.9	64.1	18.5	4	47.4	75	66.5	13
Copper dissolved (µg/l)	34	1	11	5	2.5	4	1.4	2.1	1.8	0.4
Copper total (µg/l)	34	2.5	130	25.2	26.3	4	3	49	21	21.6
Hardness ((mg/l)	34	103	340	217.8	68.5	4	153	263	219.8	48
Mercury dissolved (µg/l)	63	0.1	0.3	0.1	0	4	0.1	0.1	0.1	0
Mercury total (µg/l)	63	0.1	0.8	0.1	0.1	4	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	34	5.5	23.8	14	5.6	4	8.3	18.4	13.1	4.3
Sodium dissolved (mg/l)	11	14	60.1	42.9	15.2	4	21.7	57.3	42.3	14.9
Lead dissolved (µg/l)	63	0.1	7	0.6	0.9	4	0.1	0.3	0.1	0.1
Lead total (µg/l)	63	0.5	271	22	45.1	4	1	53.1	21.3	24.8
Selenium dissolved (µg/l)	63	0.5	2	0.8	0.5	4	0.5	1	0.6	0.3
Selenium total (µg/l)	63	0.5	4	1	0.7	4	0.5	1	0.6	0.3
Selenium total recoverable (µg/l)	13	0.5	2	0.9	0.4	4	0.5	1	0.8	0.3
Total dissolved solids (mg/l)	33	110	640	384.8	133.8	4	240	480	375	100.8
Total suspended solids (mg/l)	63	2.5	11700	700.5	1957.3	4	18	2420	758.5	1129.6
Turbidity (NTU)	61	2	7900	410.8	1294.1	4	9.6	60500	15155.4	30229.7
Zinc dissolved (µg/l)	63	5	30	6.8	4.6	4	5	20	11.3	6.3
Zinc total (µg/l)	63	5	920	85.2	140.7	4	20	150	57.5	62.4
Temperature (°C)	63	0	26.3	12.3	7.3	4	2.1	22.8	13.3	9.7
pH	63	7.5	8.8	8.2	0.3	4	7.8	8.4	8.1	0.3
Conductance (µmhos/cm)	63	250	870	580	177.3	4	390	660	570	124.3
Redox Potential (mv)	63	256	592	410	63.4	4	314	475	419	72.4
Oxygen dissolved (mg/l)	62	4.3	12.7	9.3	2	4	6.6	12.4	9.2	2.7

Table 4.11. Water chemistry data for San Juan River at Montezuma Creek Bridge

San Juan River at Montezuma Creek 1994-1999 Bridge						2000				
Parameter	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	31	59	192	122.1	30.2	4	112	140	129.3	12
Alkalinity (mg/l)	31	59	192	122.8	30.5	4	112	140	129.3	12
Arsenic dissolved (µg/l)	59	0.5	2.5	1.9	0.8	4	0.7	1.2	0.9	0.2
Arsenic total (µg/l)	59	1	21	3.5	3.5	4	0.5	3	1.3	1.2
Calcium dissolved (mg/l)	31	33.9	132	72.8	24.9	4	61.4	85.3	75	10.6
Copper dissolved (µg/l)	31	2	15	5.1	3.3	4	1.5	2.4	1.9	0.4
Copper total (µg/l)	31	1.5	120	25.3	28.5	4	5	12	9.5	3.1
Hardness ((mg/l)	31	111	465	264.2	100	4	208	300	264.3	43.8
Mercury dissolved (µg/l)	59	0.1	0.2	0.1	0	4	0.1	0.1	0.1	0
Mercury total (µg/l)	59	0.1	0.8	0.1	0.1	4	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	31	6.5	40.5	20	9.4	4	13.3	23.8	18.7	4.5
Sodium dissolved (mg/l)	7	16	196	60.1	62.3	4	32.1	59.8	45.8	12.4
Lead dissolved (µg/l)	59	0.1	4	0.5	0.5	4	0.1	0.2	0.1	0.1
Lead total (µg/l)	59	0.5	129	18.1	26.7	4	0.8	9.1	4.7	3.9
Selenium dissolved (µg/l)	59	0.5	4	0.9	0.6	4	0.5	1	0.6	0.3
Selenium total (µg/l)	59	0.5	6	1.1	0.9	4	0.5	1	0.6	0.3
Selenium total recoverable (µg/l)	13	0.5	2	0.9	0.4	4	0.5	0.5	0.5	0
Total dissolved solids (mg/l)	29	170	800	445.5	173.4	4	330	530	440	92
Total suspended solids (mg/l)	58	2.5	9100	703.4	1534.7	4	22	360	168.5	149.8
Turbidity (NTU)	58	3.9	6900	364.3	987.9	4	7.8	4080	1042.4	2025.1
Zinc dissolved (µg/l)	59	5	60	7.3	7.8	4	5	20	13.8	7.5
Zinc total (µg/l)	59	5	540	83.5	109.7	4	20	50	32.5	15
Temperature (°C)	59	-0.2	27.8	12.7	7.3	4	0.3	22.7	12.5	10.8
pH	59	7.7	8.7	8.2	0.2	4	7.9	8.3	8.1	0.2
Conductance (µmhos/cm)	59	280	1160	670	222.6	4	520	750	660	103.7
Redox Potential (mv)	59	250	516	404	63.4	4	315	469	411	73.6
Oxygen dissolved (mg/l)	58	5.1	12.3	9	1.9	4	6.9	12.6	9.3	2.7

Table 4.12. Water chemistry data for San Juan River at Bluff Bridge

San Juan River at Bluff Bridge Parameter	1994-1999					2000				
	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	65	47	175	121.9	30.6	8	115	138	131.1	9.7
Alkalinity (mg/l)	65	47	175	122	30.6	8	115	138	131.1	9.7
Arsenic dissolved (µg/l)	122	0.5	2.5	2	0.7	8	0.6	1.4	0.9	0.3
Arsenic total (µg/l)	121	0.5	20	4.2	4.4	8	0.5	3	1.8	0.9
Calcium dissolved (mg/l)	65	32.3	121	73	21.9	8	63.8	86.6	77.2	9.3
Copper dissolved (µg/l)	65	1	13	5.8	3.1	8	1.6	2.9	2.1	0.5
Copper total (µg/l)	65	1.5	200	32.4	36.3	8	4	12	8.4	2.9
Hardness ((mg/l)	65	106	507	266.4	92.6	8	221	309	272.8	38.1
Mercury dissolved (µg/l)	122	0.1	0.5	0.1	0	8	0.1	0.1	0.1	0
Mercury total (µg/l)	122	0.1	0.7	0.1	0.1	8	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	65	6.2	49.8	20.6	9.5	8	14.9	24.5	19.4	4
Sodium dissolved (mg/l)	18	18	83	48.7	22.8	8	36.8	61.7	48	10.3
Lead dissolved (µg/l)	122	0.1	4	0.6	0.7	8	0.1	0.3	0.1	0.1
Lead total (µg/l)	121	0.5	144	22.2	32.1	8	1.2	9.4	5	3.6
Selenium dissolved (µg/l)	122	0.5	3	0.9	0.6	8	0.5	1	0.6	0.2
Selenium total (µg/l)	122	0.5	8	1.2	1.1	8	0.5	1	0.6	0.2
Selenium total recoverable (µg/l)	26	0.5	1	0.8	0.3	8	0.5	1	0.6	0.2
Total dissolved solids (mg/l)	62	160	990	476.3	179.8	8	360	530	452.5	73.2
Total suspended solids (mg/l)	122	1	9820	895.8	1778.9	8	28	378	205	156.9
Turbidity (NTU)	120	2	7900	556.6	1290.4	8	7.4	2930	641.7	1152.7
Zinc dissolved (µg/l)	122	5	40	7.3	5.7	8	5	20	10.6	6.2
Zinc total (µg/l)	122	5	650	102.1	138.9	8	20	60	36.3	17.7
Temperature (°C)	122	-0.3	29.4	12.4	7.6	8	0.1	23.1	12.6	10.4
pH	122	7.7	8.6	8.2	0.2	8	7.9	8.3	8.1	0.1
Conductance (µmhos/cm)	122	280	1150	690	226.4	8	560	760	680	82.4
Redox Potential (mv)	122	4	535	403	82.4	8	283	463	400	77.1
Oxygen dissolved (mg/l)	120	5.4	12.7	9.1	2	8	6.7	12.6	9.3	2.5

Table 4.13. Water chemistry data for San Juan River at Mexican Hat Bridge

San Juan River at Mexican Hat Bridge Parameter	1994-1999					2000				
	N of cases	Minimum	Maximum	Mean	Standard Dev	N of cases	Minimum	Maximum	Mean	Standard Dev
Bicarbonate (mg/l)	34	71	180	129	27.7	4	118	138	132.3	9.6
Alkalinity (mg/l)	34	71	180	129	27.7	4	118	138	132.3	9.6
Arsenic dissolved (µg/l)	63	0.5	2.5	2	0.7	4	0.7	1.4	1.1	0.4
Arsenic total (µg/l)	63	1	50	4.8	6.9	4	1	4	2.1	1.3
Calcium dissolved (mg/l)	34	32.7	112	74.5	23.2	4	67.5	86.7	78.8	9.5
Copper dissolved (µg/l)	34	2	13	5.4	3.2	4	1.6	3.2	2.3	0.7
Copper total (µg/l)	34	1.5	170	22.7	29.9	4	5	19	9.5	6.5
Hardness ((mg/l)	34	108	460	273.9	97.5	4	236	322	280	40.2
Mercury dissolved (µg/l)	63	0.1	0.1	0.1	0	4	0.1	0.1	0.1	0
Mercury total (µg/l)	63	0.1	1.1	0.1	0.2	4	0.1	0.1	0.1	0
Magnesium dissolved (mg/l)	34	6.3	43.8	21.3	9.8	4	16.4	25.7	20.2	4.3
Sodium dissolved (mg/l)	11	15	77.5	50.2	21	4	41	65.8	50.6	11.6
Lead dissolved (µg/l)	63	0.1	1	0.4	0.2	4	0.1	0.1	0.1	0
Lead total (µg/l)	63	0.5	327	22.2	50.4	4	0.8	17.4	5.9	7.7
Selenium dissolved (µg/l)	63	0.5	2	0.9	0.6	4	0.5	1	0.6	0.3
Selenium total (µg/l)	63	0.5	5	1.2	0.9	4	0.5	1	0.6	0.3
Selenium total recoverable (µg/l)	13	0.5	2.5	1.3	0.7	4	0.5	1	0.6	0.3
Total dissolved solids (mg/l)	33	170	800	481.8	176.4	4	390	540	467.5	69.5
Total suspended solids (mg/l)	63	1	16090	1298.4	2719.8	4	36	670	234	293.1
Turbidity (NTU)	61	1	11000	722.7	1769.8	4	21	6800	1735.1	3376.7
Zinc dissolved (µg/l)	63	5	100	8.3	12.7	4	5	30	16.3	11.1
Zinc total (µg/l)	63	5	1620	108.2	223.3	4	10	70	30	27.1
Temperature (°C)	63	-0.2	29.8	12.6	7.8	4	0.8	23.7	13.1	11.3
pH	63	7.7	8.6	8.2	0.2	4	8	8.3	8.1	0.2
Conductance (µmhos/cm)	63	270	1050	690	218.3	4	610	770	700	72.7
Redox Potential (mv)	63	245	537	405	69.1	4	231	462	384	107.5
Oxygen dissolved (mg/l)	62	5.8	12.9	9.1	2	4	6.4	12	9	2.6